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LANDSAT DATA CONTINUITY MISSION

OPERATIONAL LAND IMAGER (OLI)

SURVEILLANCE PLAN

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National Aeronautics and
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LDCM PROJECT
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1.0 INTRODUCTION

The Landsat Data Continuity Mission (LDCM) is a joint mission implemented by the National Aeronautics and Space Administration (NASA), United States Geological Survey (USGS), and the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO). The LDCM provides remotely sensed, highly-calibrated, moderate resolution, multispectral imagery affording systematic global coverage of the Earth's land surfaces on a seasonal basis and to make the data readily available for large-scale and long-term Earth System Science and Land use/land cover change research and management

This document is the LDCM Implementation Phase Surveillance Plan, identifying the Safety and Mission Assurance (SMA) activities to be performed during the LDCM's Formulation and Implementation Phases. The scope of the LDCM Project and the roles and responsibilities in this document are based on the plan to fly two LDCM instruments, the Operational Land Imager (OLI), on board the two planned NPOESS 2130 spacecraft.

1.1 PURPOSE

The purpose of the LDCM Implementation Phase Surveillance Plan is to define the approach to planning and executing the Safety and Mission Assurance activities associated with the Implementation and Formulation Phases of the LDCM OLI development life cycle. The LDCM Risk Management Plan and Mission Assurance Requirements (MAR) that were base-lined during the Formulation Phase of the LDCM Project are an integral part of this surveillance plan. This plan is commensurate with the Project's identified risks for the implementation phase.

This plan identifies SMA strategies used for oversight. Surveillance activities are described and processes for a continuous measure of contract performance are defined. Identified are responsible individuals, specific areas to be placed under surveillance, planned frequency of surveillance, and associated metrics.

The surveillance program will address the space segment for LDCM, which includes the instruments and flight software as well as ground support equipment and associated software. This plan applies to the formulation, implementation, and operations phases of the LDCM project, including integration, test, shipment, launch, deployment, checkout, and launch and early orbit operations and activation.

1.2 LDCM BACKGROUND

The Landsat Data Continuity Mission (LDCM) is a component of the Landsat Program being conducted jointly by the National Aeronautics and Space Administration (NASA) and the United States Geological Survey (USGS) of the Department of Interior (DOI). The LDCM goals are in keeping with the Landsat programmatic goals stated in the Land Remote Sensing Policy Act of 1992 (Public Law 102-555) and the Commercial Space Act of 1998 (Public Law 105-303). This policy requires that the Landsat Program provide data into the future that is sufficiently consistent with previous Landsat data to allow the detection and quantitative characterization of changes in or on the land surface

of the globe. The LDCM was conceived as a follow-on mission to the highly successful Landsat series of missions, which have been providing satellite coverage of the Earth's continental surfaces since 1972. The data from these missions constitute the longest continuous record of the Earth's surface as seen from space.

1.3 LDCM SYSTEM OVERVIEW

The LDCM consists of two Operational Land Imager (OLI) instruments hosted on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) 2130 spacecraft and the Payload Operations Control Center, archive, and distribution system, provided by the United States Geological Survey (USGS) required to disseminate LDCM data. The USGS portion of the LDCM is not covered by this plan.

The OLI instrument will be designed and built to fly in an 828-km polar, sun-synchronous orbit with a 9:30 am descending node, equatorial-crossing time. OLI data will be stored onboard in its integral Data Storage and Playback (DSAP) unit until such time that it can be downlinked via the NPOESS SafetyNet.

The GSFC LDCM Project will provide the OLI instrument and accommodation hardware, IPO will provide the host spacecraft, mission operations, and the SafetyNet ground receive sites, and the USGS will provide OLI payload operations and science data processing and archiving.

Upon successful delivery of the second OLI instrument to the IPO, and the completion of the OLI contract, this plan becomes null and void.

1.4 ROLES AND RESPONSIBILITIES

GSFC provides surveillance for the OLI instruments. The IPO and the IPO's contractors provide primary surveillance for the spacecraft and associated ground elements, and the USGS provides surveillance of its contractors performing system upgrades to support the LDCM data processing and archive. Although the following Reference and Applicable documents are not imposed on the USGS or the NPOESS contract, NASA maintains a cooperative relationship with the USGS and the IPO which facilitates the flow of information necessary for NASA to provide surveillance of the instrument activities. This Surveillance Plan details the strategies to be employed by GSFC in ensuring successful instrument program implementation.

1.5 REFERENCE DOCUMENTS

NPR: 7120.5C, NASA Program and Project Management Processes and Requirements, NASA Procedures and Guidelines, March 22, 2005.

ANSI/ASQ Q9001-2000, Quality Management and Quality System Elements – Guidelines, American Society for Quality Standards Committee for American Standards Committee Z-1 on Quality Assurance, 2000.

LDCM Configuration Management Plan, GSFC XXX-XX-XX-XXX

Memorandum of Agreement Between NASA and DoI and DoD for the Development and Implementaiton of the Landsat Data Continuity Mission, Draft, Date TBD.

1.6 APPLICABLE DOCUMENTS

LDCM Risk Management Plan (RMP), GSFC XXX-XX-XX-XXX

LDCM System Engineering Management Plan (SEMP), GSFC XXX-XX-XX-XXX

OLI Mission Assurance Requirements (MAR), 427-50-01-005

2.0 SAFETY AND MISSION ASSURANCE SURVEILLANCE STRATEGY

In general, the LDCM Project surveillance strategy will take four primary forms:

a. Formal participation in various working groups, reviews, surveys, audits, technical interchange meetings and inspections;
b. Informal discussions, telecons, reviews, and meetings between NASA and contractor personnel;
c. Review of metrics;
d. Mandatory inspection of contractor work.

The LDCM Project will employ both the "insight" and "oversight" concepts of management and surveillance.

2.1 GSFC SURVEILLANCE METHODOLOGY

Monthly & Quarterly Status Reviews, technical progress interchanges, and meetings of working groups are planned. These activities will be conducted as face-to-face meetings or teleconferences, as appropriate. Visibility gained through this formal and informal participation in the instruments' activities will be used as a primary means of collecting information to measure contract performance.

The LDCM resident engineers at the instrument contractor facility, as well as the resident Defense Contract Management Agency (DCMA) personnel will provide oversight of LDCM activities through participation in various management meetings, product inspections, monitoring or witnessing tests, and assessing processes. Through these activities they will seek objective evidence and data that the contractors' quality programs and processes are commensurate with the importance of the LDCM program and are compliant with contractual requirements.

2.2 CONTRACTOR SMA SYSTEMS

The LDCM SMA contract requirements are based on a subset of the GSFC Mission Assurance Guidelines and were chosen based on the contract type and level of risk associated with the procurement. The LDCM Project has encouraged the use of contractor practices and procedures that have been proven on previous NASA programs. SMA surveillance is performed in conjunction with the LDCM contractors' internal performance assurance activities.

For the LDCM Project's OLI instrument, the contractor will be responsible for implementing and maintaining compliance to the LDCM OLI Instrument Mission Assurance Requirements and their internal procedures. The contractor must also flow those requirements down to their subcontractors and verify compliance. The standards imposed on their subcontractors include quality assurance, source inspections, and objective evidence of quality.

2.3 SURVEILLANCE TEAM

The Surveillance Team will consist of the following organizations and specific members:

2.3.1 LDCM Project Office

The LDCM Project Office is responsible for executive management of project objectives within guidelines and controls prescribed by NASA Headquarters and GSFC management. Technical assistance and support will be available as needed through the project office for development and production of the LDCM.

2.3.2 LDCM Project Manager (PM)

The PM is responsible to the GSFC Director of Flight Programs and Projects through the Earth Science Program Office for managing the LDCM program life cycle. The PM is the senior official responsible for providing overall direction for surveillance activities as they pertain to this plan. The PM consults with its partners as necessary to ensure coordination of priorities and schedules.

2.3.3 LDCM Deputy Project Manager (DPM)

The DPM leads a team of technical specialists who support the LDCM development and production effort. The DPM assumes full responsibility for directing the surveillance program in the absence of the PM.

2.3.4 GSFC Systems Assurance Manager (SAM)

The SAM, assigned by the Chief of the Office of Systems Safety and Mission Assurance, is responsible to the PM for implementing the activities of the Project Surveillance Plan. The SAM will manage and coordinate support as required from the LDCM Project, the various GSFC Code 300 divisions and matrixed personnel from other GSFC organizations.

2.3.5 GSFC Quality Engineers (QE)

GSFC QEs are responsible for providing technical QA support to the SAM in support of the instruments and spacecraft development, integration, test, and launch site activities as required.

2.3.6 LDCM Quality Assurance Representative (QAR) residents

Resident QARs located at LDCM contractor facilities provide in-house support to the LDCM SAM. The QARs will interface with the LDCM Project to provide technical support as required, and provides feedback to the SAM on current status and issues.

2.3.7 LDCM DCMA Residents

DCMA will be delegated certain in-plant quality assurance responsibilities at the LDCM contractor facilities. DCMA will also be given re-delegation authority for the contractor's sub-tier suppliers.

2.3.8 NPOESS Spacecraft Interface

The LDCM project will work closely with the IPO to ensure all matters concerning interface of the OLI to the NPOESS spacecraft and spacecraft-level integration and testing are worked in a team environment to mutual resolution.

2.4 INTERFACES/INFORMATION FLOW

Close communication will be maintained between all members of the LDCM Project Surveillance team to ensure that the surveillance role is performed effectively. Various means will be used to maintain information flow as summarized below.

- Resident QARs will provide a written summary of the activities performed in a weekly form or more often as circumstances warrant.
- DCMA will provide notification of discrepancies noted during their surveillance activities and interfaces with the SAM as necessary to ensure issues are addressed by the contractor.
- The SAM will report critical LDCM activities to Code 300 management and to Code 300 via the Code 303 Weekly Report.
- Weekly telecons will be held between the Project and the OLI instrument contractor. All members of the Surveillance Team participate as required.

2.5 PRODUCT VERIFICATION (INSPECTION)

The LDCM Surveillance Team will use two methods of product verification: direct examination and indirect examination. The selection of the method of choice for any given situation will be determined through mutual consent between the Project and instrument contractor. The criteria for analyzing the results of these examinations may range from simple drawing compliance to complex issues relying upon the judgment of scientific and engineering specialists.

a. Direct examination can take a variety of forms, first and foremost being inspection of hardware against the relevant drawings, specifications, etc. Examinations may take the form of non-destructive evaluations such x-ray fluorescence for plating thickness verification, or sample destructive examinations such as total ionizing dose tests for microcircuits or printed wiring

board cross section examinations. If agreed to by the contractor, GSFC may use its facilities to perform direct examinations of selected critical hardware.

b. Indirect examination will be used when direct examination is not possible. Methods of indirect examinations may include inspection of LDCM similar hardware produced on the same production line by the same personnel as the flight hardware. It may consist of non-destructive and/or destructive examinations of coupons, lot acceptance test samples, and material examinations, which may be performed at GSFC.

2.6 SYSTEM LEVEL REVIEWS

NASA and its partners monitor OLI development through a series of management review meetings held at various points during development of the OLI. The details of the system-level review program are described in the System Engineering Management Plan (SEMP). The GSFC Code 301 Review Chairman chairs the major reviews and appoints a review team for the OLI reviews. The purpose of the Code 301 review board is to independently evaluate the technical aspects of the OLI at major milestones. The reviews are co-chaired, as appropriate, by partner agencies. The Integrated Program Office ensures that the LDCM Project team and, in turn, the Code 301 Review Team are notified of NPOESS spacecraft milestone reviews such that OLI interfaces are properly reviewed..

Issues arising from the major reviews are identified by the Code 301 review panel. Requests for action or information are submitted to the LDCM Project for response. These issues are addressed by LDCM Project Management in conjunction with the respective developers as necessary and submitted to Code 301 for closure.

An Independent Review Team will be sponsored by NASA Headquarters. Its purpose is to independently assess all technical, schedule and cost aspects of NASA's contribution to the LDCM. Findings are reported to NASA Headquarters Earth Science Enterprise. The review team consists of subject matter experts from across the aerospace industry.

2.7 REVIEW BOARDS

GSFC LDCM Systems Assurance personnel and Project engineers will be involved on the following review boards, as described below.

- Configuration Control Boards (CCB) for the OLI instrument;
- Parts, Materials, and Processes Control Boards (PMPCB) for the OLI instrument;
- Material Review Boards (MRB) for the OLI instrument;
- Failure Review Boards (FRB) for the OLI instrument.

Participation in Review Boards is a very important function of the surveillance process. GSFC participation in the PMPCBs, MRBs and FRBs is mandatory. Participation will include, but not be limited to the following activities:

- Preparation to become familiar with the technical and programmatic issues involved;

- Independent analysis and development of potential options, recommendations and tradeoffs;
- Review of contractor, partner or subcontractor analyses and recommendations;
- Clear understanding of the risks and benefits to the LDCM program for each board action and clear articulation of this information to the project and contractor participants.

In the interest of facilitating open communications, LDCM surveillance team members will communicate all findings and opinions to their contractor counterparts in a timely manner.

2.8 AUDITS

In accordance with LDCM quality requirements, the OLI instrument contractor will have an internal audit program in place to determine the adequacy and conformance of processes to the requirements. As an element of the surveillance process, GSFC representatives will participate in joint contractor audits to the extent possible.

Audits will be conducted in accordance with the contractor's standard practices and policies. GSFC audit participants may generate an independent opinion, which will be provided in writing to the contractor representative and the project SAM. The contractor will submit audit reports to the resident Quality Assurance Representative, who will summarize relevant information concerning audits to the project SAM on a regular basis.

2.9 RELIABILITY ASSURANCE

GSFC reliability engineering personnel will be available to participate in all reviews, audits, teleconferences, and other meetings as requested by the project to provide insight/oversight support of all reliability and risk management related activities as allowed by the Statement of Work and Mission Assurance Requirements. GSFC reliability engineering personnel will review all applicable data item deliverables and provide guidance when requested by GSFC project management. GSFC reliability engineering will develop an instrument-level Probabilistic Risk Assessment and Fault Tree Analysis to assess, manage, and if necessary, quantitatively assess the need to reduce program risk.

2.10 SAFETY

The implementation of safety engineering guidelines is the responsibility of the contractors' system safety programs as required by contractual documents. The LDCM project will provide inputs to the NPOESS Missile System Prelaunch Safety Package, which must demonstrate that the spacecraft, the OLI instrument, external interfaces, ground support equipment, and procedures comply with the safety requirements in AFSPC-MAN-91-710, "Range Safety User Requirements Manual". Launch site plans and procedures will be provided by the NPOESS IPO.

The primary responsibility for monitoring safety issues and documentation for GSFC is assigned to the LDCM Project Safety Manager and GSFC Code 302 contractor support.

The surveillance team will interface with the cognizant LDCM project engineers and other GSFC organizations as required. The surveillance team will work with the instrument contractor, NGST, IPO, USGS, and GSFC representatives to ensure all safety requirements are fulfilled and any non-compliances are successfully resolved prior to launch.

2.11 PARTS, MATERIALS AND PROCESSES CONTROL BOARD (PMPCB)

2.11.1 The LDCM parts program is supported by the Code 562-assigned Project Parts Engineer (PPE). The OLI Instrument MAR prescribes the use of Level 1 parts capable of meeting a 7 year effective mission life in accordance with GSFC 311-INST-001. The LDCM parts control program is governed by the Parts Control Board consisting of the LDCM PPE, the PPE, and cognizant design engineers, system specialists, subsystem managers, etc., who are invited to participate. Parts intended for use in the OLI instrument are maintained in Parts Identification Lists and reviewed by the PCB for compliance to mission reliability goals. Part procurement specifications are prepared as needed by either PPE for EEE parts requiring additional screening or qualification testing to meet LDCM part requirements.

The LDCM PPE and other surveillance team personnel will participate, but not be limited to, the following activities:

- PMP Control Board activities;
- Review of Parts Lists and Materials Lists;
- Drawing and document review of manufacturing processes;
- Design of experiments to evaluate new and existing processes;
- Quantitative and qualitative analyses of parts, materials and processes;
- Failure analyses;
- Contractor and subcontractor handling of PMP issues.

2.11.2 A senior Code 541-assigned Materials Assurance Engineer (MAE) is responsible for recommending, reviewing and approval of all materials used on the OLI instrument. The MAE, a member of the GSFC Materials Engineering Branch, will administer the materials program as specified in the LDCM MAR and in compliance with 541-PG-7120.2.1, Materials Engineering Support Guidelines for GSFC.

Some of the principal duties of the MAE include, but are not limited to:

- Participate as a permanent member of the LDCM PMPCB;
- Attend and participate at Peer and Design Reviews;
- Attend and participate at LDCM Project meetings;
- Review Materials and Processes Control Plans;
- Review and/or approve Materials and Processes Lists;
- Reviews and/or approves Materials Usage Agreements or waivers concerning materials issues;
- Provide expertise in the selection of flight materials and processes;
- Participates in parts and materials failure analyses and Failure Review Boards as requested;

- Cooperates with the LDCM Project Contamination Control Engineer to assure required cleanliness control of hardware;
- Perform any other duty associated with a successful flight materials program.

2.12 PERFORMANCE VERIFICATION

Performance verification refers to the testing of components, spacecraft and OLI instrument subsystems and the fully integrated spacecraft and payload combination. The OLI instrument contractor will submit test plans and procedures describing the planned performance verification tests. The surveillance team will review these documents while considering that many of the elements of the payload are new designs or substantial modifications of existing designs, while other elements have been used successfully on previous missions.

Listed below are typical activities to be conducted by LDCM surveillance team engineers for contractor and subcontractor surveillance:

- Participate in pre-test walkthroughs and test readiness reviews;
- Review and comment on test plans, methods, and procedures prior to their application to any flight hardware;
- Participate in post-test reviews;
- Participate in Failure Review Board activities;
- Perform independent analyses of anomalies and failures.

3.0 APPENDIX – A ACRONYM LIST

AFSPC	Air Force Space Command
ANSI	American National Standards Institute
ASQ	American Society for Quality
CCB	Configuration Control Board
CCR	Configuration Change request
DCMA	Defense Contract Management Agency
DPM	Deputy Project Manager
EEE	Electrical, Electronic, and Electromechanical
FRB	Failure Review Board
GSFC	Goddard Space Flight Center
IPO	Integrated Program Office
LDCM	Landsat Data Continuity Mission
MAE	Materials Assurance Engineer
MAR	Mission Assurance Requirements
MRB	Material Review Board
NASA	National Aeronautics and Space Administration
NGST	Northrop Grumman Space Technology
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
OLI	Operational Land Imager
PM	Project Manager
PMP	Parts, Materials and Processes
PMPCB	Parts, Materials and Processes Control Board
PPE	Project Parts Engineer
PVP	Performance Verification Plan
QAR	Quality Assurance Representative
QE	Quality Engineer
RMP	Risk Management Plan
SAM	Systems Assurance Manager
SEMP	System Engineering Management Plan
SI&T	System Integration and Test
SMA	Safety and Mission Assurance
SSMAP	Systems Safety and Mission Assurance Plan